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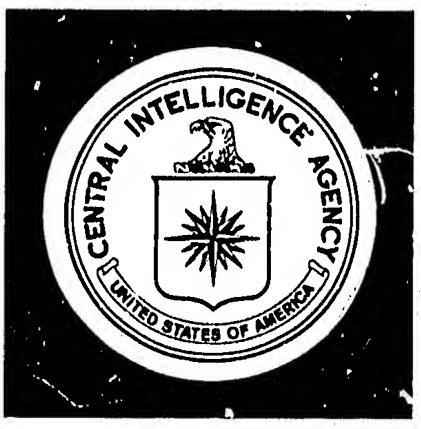

Research Aid

People's Republic of China: Chemical Fertilizer Supplies, 1949-74

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PEOPLE'S REPUBLIC OF CHINA: CHEMICAL FERTILIZER SUPPLIES 1949-74

KEY FINDINGS

1. The Chinese fertilizer industry grew from only two plants producing 27,000 metric tons a year in 1949 to at least 40 large and hundreds of small plants producing 25 million tons in 1974. Despite this expansion in output, China has been the world's largest importer of fertilizer in recent years. Currently, the fertilizer industry is configured as follows:

- Small plants now play an equal role in nitrogen output, using local raw materials to produce aqueous ammonia and ammonium bicarbonate.

- Nitrogen fertilizer production in large plants has grown steadily, except for sharp drops in 1961 and 1967. Growth was spurred in the mid-1960s by the purchase of a large urea plant from the Netherlands, which provided Peking with technology it subsequently copied.

- Phosphate fertilizer production is largely from small plants using domestic rock; the few large superphosphate plants use imported rock.

- Production of potassium fertilizer is low, despite large natural salt deposits in the western provinces.

2. Shortcomings in the fertilizer industry were highlighted by the poor harvest in 1972, which convinced Peking that agriculture needed more fertilizer and other inputs to help mitigate the effects of bad weather and allow agricultural output to keep pace with population growth. Unable to rapidly expand fertilizer production from domestic resources, China in late 1972 contracted for 13 of the world's largest ammonia-urea complexes from US, Netherlands, French, and Japanese firms.

- Upon completion in the next two to three years the imported plants will provide 3.5 million tons of nitrogen annually.

- Imports of nitrogenous fertilizer will be largely eliminated.

- The rate of construction of new small plants (which has slowed in recent years) will continue to decline, but they will remain an important source of fertilizer -- particularly phosphate.

3. The large expansion in fertilizer supply by the end of the decade could result in rapid increases in agricultural output. However, the full benefit of the increased supply will be realized only if complementary inputs such as advanced seed strains and improved water control features are adequately developed. We believe it unlikely that Peking will carry out these complementary tasks to the extent required, particularly in agricultural research.

DISCUSSION

Introduction

4. Agriculture is progressing with the aid of such inputs as water control systems, mechanized farm tools, and agrochemicals. Because the amount of land suitable for cultivation in China is limited, however, chemical fertilizer has been and will remain the key to sizable gains in agricultural output.

5. This study surveys the present situation and future prospects for fertilizer supply in China and reviews production techniques, resources, and development policy. Notes on the methodology used to make the estimates are presented in the appendixes.

Fertilizer Supply

Background

6. China produced only 27,000 tons of chemical fertilizer in 1949,[1] the first year under Communist control. The pre-Communist record of 227,000 tons produced in 1941 was not surpassed until 1953, and output did not reach one million tons per year until 1958. By 1960 a program using local building materials and raw materials in small plants began to grow in importance. Fertilizer assumed a central role in agricultural progress, and its output has subsequently grown rapidly except in the aftermath of the Great Leap Forward and the Cultural Revolution periods.[2]

7. Nevertheless, in the 1970s China has remained the world's largest importer of fertilizer, purchasing more than one million tons of nutrient each year since 1967. The process of achieving self-sufficiency in fertilizer, and therefore in grain, has not moved rapidly enough.

1. For a discussion of Chinese fertilizer reporting practices, see Appendix A.
2. For a detailed examination of China's fertilizer supply since 1949, see Appendix B.

Present Supply

8. In contrast to gains of 14% and 17% in 1972 and 1973, China's total fertilizer supply declined 7% in 1974 (see Table 1). The increase in domestic production of chemical fertilizer in 1974 was negligible as increases in nitrogenous and potassium output were offset by a sharp decline in phosphorus production. Phosphate fertilizer production declined 11% (despite increased domestic mining of rock) because of a reduction in rock imports. Disruptions related to the campaign to criticize Lin Piao and Confucius caused transportation bottlenecks and coal shortages. While output from large nitrogen fertilizer plants increased almost 17%, difficulties with coal supplies held the output of small nitrogen fertilizer plants to constant gains in 1974. Potassium output increased by about 7% during the year.

9. Overall fertilizer imports fell 33% in 1974. Purchases of phosphate rock fell off sharply, as Morocco led world producers in quadrupling prices. Nitrogen fertilizer imports for the year also dropped, as shipments from Japan scheduled for the last quarter were postponed until 1975.

Resources

10. China has significant supplies of raw materials for the production of all three major nutrient types. Coal is found in abundance throughout the country and has been the main source of raw materials for the nitrogenous fertilizer industry. Extensive oil-related gas deposits and natural gas fields in Szechwan Province are increasingly being used as feedstock for plants that produce ammonia to be processed into urea. Domestic phosphate deposits in many areas have supported production, particularly in the small plant program, which provides most of the phosphate fertilizer production. Extensive potassium supplies are available in the Tarim and Tsaidam Basins in the far western part of China, but these areas are far from major agricultural areas. Secondary sources of potassium have been sea salt recovery operations.

Products and Plant Types

11. Small plant ammonia production began in 1958 from units with capacities of 800 tons per year. These were later increased to 3,000 tons per year, and by the mid-1960s large plants with capacities of up to 40,000 tons per year were developed. The small plant program gained momentum with the development of the ability to produce complete sets of fertilizer plant and equipment within China.

Table 1

China: Supply of Chemical Fertilizer in Standard Units[1]

Million Metric Tons

	Production					
	Total	Nitrogen	Phosphorus	Potassium	Imports	Supply
1949	0.03	0.03	....	....	....	0.03
1950	0.07	0.07	....	....	0.10	0.17
1951	0.14	0.14	....	....	0.20	0.34
1952	0.19	0.19	....	....	0.20	0.39
1953	0.26	0.26	....	....	0.40	0.66
1954	0.34	0.34	....	....	0.68	1.02
1955	0.43	0.42	0.01	....	0.79	1.22
1956	0.66	0.59	0.08	....	1.35	2.01
1957	0.80	0.68	0.12	....	1.34	2.14
1958	1.35	1.01	0.34	....	1.80	3.16
1959	1.88	1.38	0.50	....	1.35	3.23
1960	2.52	1.72	0.80	....	1.08	3.60
1961	1.85	1.40	0.45	....	1.12	2.98
1962	2.78	2.22	0.56	....	1.20	3.98
1963	3.86	2.71	1.15	....	2.70	6.56
1964	5.78	3.56	2.22	....	1.80	7.58
1965	7.60	4.15	3.45	....	3.20	10.80
1966	9.60	4.83	4.68	0.09	3.61	13.21
1967	8.10	4.04	3.89	0.17	5.73	13.83
1968	9.50	5.20	4.07	0.23	6.13	15.63
1969	11.30	5.90	5.15	0.25	6.56	17.86
1970	14.00	7.81	5.90	0.29	7.41	21.41
1971	16.80	9.50	6.95	0.35	7.39	24.19
1972	19.84	11.72	7.74	0.38	7.74	27.58
1973	24.80	14.65	9.73	0.42	7.43	32.23
1974	24.88	15.81	8.62	0.45	5.00	29.88

1. Appendix B presents notes on the derivation of the production series. The import figures were derived from export data of major trading partners.

12. The quality of the output produced by this sector – primarily aqueous ammonia and ammonium bicarbonate – has often been questioned by Western observers, but the Chinese consistently have claimed that small plant output is suitable for their purposes. There are, nonetheless, problems with the products. Aqueous ammonia must be shipped in closed containers to slow the loss of its already low – about 17% – nitrogen content into the atmosphere. Ammonium bicarbonate, the main product, is unstable and cannot be stored for long periods, particularly when not under cover. Neither fertilizer comes near urea's 46% nitrogen

content and is thus of a lesser value per unit weight. Distribution also is a problem because demand is highly seasonal.

13. Ammonium nitrate production has been divided between military and industrial explosives and agriculture in its final uses. With a nitrogen content above 30%, it is a useful fertilizer despite physical properties that lead to caking through absorbing moisture from the air and to spontaneous explosion under conditions of high temperature or pressure.

14. Urea production began on a pilot plant scale during the late 1950s. The high nitrogen content of urea and its relative ease of handling and application in its prilled form make it superior to ammonium sulfate and the volatile ammonium bicarbonate. However, the ability to produce prilled urea in commercial quantities came only after the purchase of a large urea plant from the United Kingdom and the Netherlands in the mid-1960s. This 175,000-ton-per-year facility, located at Lu-chou in Szechwan Province, was examined closely by Chinese technicians; since then a number of standardized urea plants, each with a capacity of 40,000 tons per year, have been domestically manufactured.

15. Phosphate fertilizer production has not expanded as rapidly as nitrogen production and is an important concern of the Chinese. Relatively little finished phosphate fertilizer is imported. Instead, phosphate rock, predominantly Moroccan, is purchased for conversion into single or triple superphosphate by large domestic plants. Small plants, which depend on domestic rock deposits, currently provide most of the phosphate fertilizer supply. However, many small plants do little more than crush the rock before it is spread on the fields.

16. Potassium production in China is limited despite large potash deposits in the western provinces. Two plants, both in Tsinghai Province, use carnallite, a natural salt, to produce potassium fertilizer. In Fukien and other eastern provinces, sea water is treated to obtain several salts, including potassium chloride and a potassium-magnesium fertilizer.

17. Finally, organic fertilizers have been and will continue to be of great importance in Chinese agriculture. Night soil is collected regularly, and hogs are lauded in the press as fertilizer factories. Probably as a result of the decline in supply in 1974, the use and production of organic substances is currently being widely publicized and praised for its results.

Development Policy

18. In spite of significant growth in fertilizer production throughout the 1960s and early 1970s, imports remained high. At the same time, application rates in China were far below those of many of its neighbors. The inadequacies of the domestic fertilizer industry were highlighted by the poor harvest of 1972, which convinced Chinese policymakers that agriculture required more fertilizer and other inputs to cushion the effects of bad weather. A population growth rate of 2% necessitated rapidly increasing agricultural output. Beginning in late 1972, China contracted for 13 of the world's largest ammonia-urea complexes from US, Netherlands, French, and Japanese firms (see Table 2). The decision to seek equipment abroad was dictated by China's inability to rapidly expand fertilizer production from domestic resources.

Table 2

China: Purchases of Nitrogenous Fertilizer Plants
November 1972 - May 1974

Number of Plants	Type	Daily Capacity (Million Metric Tons)	Exporting Country	Period of Construction
8	Ammonia	1,000	United States	1975-77
8	Urea	1,620	Netherlands	1975-77
2	Ammonia	1,000	Japan	1976-77
2	Urea	1,600	Japan	1976-77
3	Ammonia	1,000	France	1976-77
3	Urea	1,740	France	1976-77

Large Plants

19. Each of the 13 ammonia plants being imported will have a daily capacity of 1,000 tons which will serve as feedstock to associated urea plants, each of which will produce 1,600 tons per day or more. Upon completion in the next two to three years, these plants will provide 3.5 million tons of nitrogen annually, more than the 3.2 million tons of nitrogen produced in China in 1974. China recently became the world's fifth largest producer of natural gas, and the urea plants will use gas as feedstock.

20. The prime motivation to import plant and technology was the inability of China's agricultural sector to provide adequate harvests in years of unfavorable growing conditions. The solution to the problem was to increase industrial inputs to agriculture by greatly increasing the nation's capacity to produce fertilizer. Higher urea production was seen as the necessary base of such an expansion because of agriculture's dependence upon nitrogen and the economies in production, storage, transportation, and application of urea itself. However, domestic shortages of technology in equipment design, inadequate supplies of key materials – such as stainless steel – and the limited capability of the machine tool industry worked together to prohibit rapid increases in urea plant capacities. Prices of imported equipment also began to look more attractive as world prices for fertilizer and oil increased rapidly. For example, the eight complexes purchased from the United States and the Netherlands alone cost less than the 2.2 million tons of urea imported in 1973 at 1974 prices, yet they could produce twice that amount yearly.

21. Tightness in the world fertilizer market was an early factor reinforcing China's decision to acquire imported fertilizer technology and equipment. In spite of increases of 6.1% and 7.2% in production during 1972 and 1973, world stocks of nitrogen fertilizer and phosphate rock were drawn on to meet demand. In its negotiations for fertilizer imports, Peking faced rising prices and increased uncertainty as to the availability of future supplies.

22. In late 1973, tremendous increases took place in the price of oil, a feedstock for ammonia production. Consequently, urea prices moved up so strongly that 1973 imports valued at $175 million would have cost $300 million in 1974. The most important price effect on Chinese imports, however, was the quadrupling in the price of Moroccan phosphate rock to $43 per ton in early 1974. Subsequent increases to $68 per ton led Peking to cut imports drastically.

23. By late 1974 the Chinese were also experiencing shortages of foreign exchange, as their export sales fell off in the face of the world recession. Shipments of Japanese fertilizer scheduled for November and December, involving 150,000 tons of urea and 60,000 tons of ammonium sulfate, were postponed to early 1975. In addition, Peking requested delayed payment for ammonium chloride purchased from Japan.

24. An easing of prices and product availabilities has characterized the world fertilizer market in recent months. As a result, fertilizer imports by Peking during the last half of 1975 will be obtained at sharply reduced prices, conserving foreign exchange, which continues in short supply. Despite lower product prices, however,

the imported urea plants remain a prudent purchase by virtue of their ability to relieve China's need to import nitrogen fertilizer and its dependence on a fluctuating world market.

Small Plant Program

25. Small plants have played an important role in the development of China's fertilizer industry. An experimental program began in 1958, and 10 years later small nitrogen plants accounted for one-third of the national nitrogen productive capacity. By 1973, China had more than 1,400 small chemical fertilizer factories producing 63% of total fertilizer output, 75% of the phosphates, and 54% of the nitrogen fertilizer.

26. Savings accrue from reduced construction time, smaller investment, and forgoing the necessity of transporting large quantities of materials. Construction requires only one-third the time of large plants and is planned around local conditions to utilize local building materials whenever possible. Also, using local manpower in plant operations develops a large pool of trained workers.

27. The major benefits of the program derive from the location of the plants close to end users and raw material sources. Using plants scaled to meet local demand for fertilizer eliminates reliance on an already strained transport net and helps solve the problem of moving bulky aqueous ammonia and ammonium bicarbonate, which are susceptible to deterioration during shipping.

28. The wide distribution of small plants further reduces dependence on the transport system through using locations near sources of raw materials. In addition, plants and technologies may be varied in order to more adequately use materials as they exist in a specific area. By early 1973, 44% of all small nitrogen fertilizer plants had been switched to powdered coal and other local resources, releasing coke and hard coal for alternative uses.

29. The small plant effort has used natural and human resources that might otherwise have remained dormant and has assumed the major role in fertilizer production. However, the rate of construction of new plants has slowed because they already are widely distributed throughout the countryside.

30. There is little doubt that the small ammonia plants will play a smaller relative role after the imported urea complexes come on stream. The output of the 13 large plants alone will surpass total nitrogen fertilizer produced in 1974,

of which half was provided by small plants. As the imported plants assume the major role in the growth of nitrogen output, however, small plants are likely to become the principal means by which the supply of phosphorus will be increased in order to maintain the nutrient balance. By 1980 this would call for nearly 21 million tons of standard weight phosphorus fertilizer, an increase of about 150% over present levels.

Prospects

31. The Chinese will not reach the Fourth Five-Year Plan (1971-75) goal of a total annual supply of 35 million tons of chemical fertilizer this year. Domestic output is unlikely to increase appreciably, and continued tightness of foreign exchange will probably hold fertilizer imports in 1975 below the level of 1973. However, oil income not diverted to plant and equipment purchases or used to offset the growing trade deficit might boost imports slightly above the depressed 1974 level.

32. Recent Chinese attention to aid projects for Morocco may indicate an interest in renewing flows of phosphate rock at reduced prices. In any case, domestic output is being expanded to fill the gap, and compound fertilizer, in which the Chinese have shown recent interest, may be sought to provide sufficient phosphorus. The high level of Chinese purchases of Canadian potassium chloride over the past two years is likely to continue in the future.

33. Emphasis in the Chinese press on the production and use of organic fertilizer has been increased lately. The stress on organics suggests that there is little official hope of any substantial increase in the supply of chemical fertilizer over the short run.

34. Over the longer term, the key to increased output is the prompt completion and bringing into full production of the 13 imported urea plants. The first of these is expected to begin working in early 1977, with completion of the remaining plants scheduled in 1978. Construction lags and a lack of sufficiently trained Chinese technicians, however, may prevent a rapid rise to full plant productivity. Nevertheless, the output from the new plants plus the expected production from existing plants should enable China to produce 8 million tons of nitrogen fertilizer by 1980, relieving the need to import nitrogenous fertilizers.

35. This massive expansion in fertilizer supply could result in rapid increases in agricultural output by the end of the decade. The ability to fully utilize the

increased supply of fertilizer, however, will depend upon the development of complementary inputs. Without improved water control and advanced seed strains, returns on unit fertilizer applications will decline. The most suitable of China's arable lands are already under water control. Much of the remainder is either unsuitable for such projects or, as in North China, will require large, multipurpose works -- high dams, extensive reservoir and delivery systems, and soil conservation programs. Numerous labor-intensive agricultural construction projects have been completed, but there is no indication that China is ready to undertake the large-scale projects to the extent required.

36. China continues to import and to develop high-yield varieties of seeds. Such strains require and respond to large doses of fertilizer. In addition to the problems of wide distribution and acceptance by the peasantry, these seeds require adequate water control if they are to be successful. Potential yields are unlikely to be realized as fertilizer inputs are increased if these problems are not addressed by the government.

37. The use of potassium fertilizer is likely to rise several fold by 1980. Despite considerable native potash deposits, the transportation network necessary to service the major locations in the western provinces can be developed only over the long term. Thus, annual potash imports of 2 million tons may be required by 1980.

38. The mixed performance of the fertilizer industry is in part a reflection of the inadequacies of some of China's other large industries. In spite of the major campaign since 1962 to push agriculture ahead with industrial inputs, certain sectors of the chemical, machine tool, and metals industries have been unable to meet the challenge. Large-scale production of prilled urea in China resulted only after the purchase and copy of foreign equipment. Even then, only medium-sized plants could be produced through the cooperation of these three industries. These industries will again be tested in the decade of the 1980s after the imported plants are in production. Maintenance of the accelerated growth rates of fertilizer output brought about by China's acquisition of the plants will depend upon the ability of these industries to provide additional large-scale chemical equipment for fertilizer production.

APPENDIX A

CHINESE PRACTICES OF REPORTING FERTILIZER OUTPUT

We believe that the PRC is currently reporting the output of chemical fertilizer in standard units rather than as gross weight. In the late 1950s, when the Chinese published detailed information on the fertilizer industry, the output of various types of fertilizer was usually expressed in terms of these units. The standard unit refers to the nutrient equivalent of three basic fertilizers – ammonium sulfate (20% N), super phosphate (18.7% P_2O_5), and potassium sulfate (40% K_2O). For example, one million tons of urea fertilizer would be counted as 2.3 million tons of standard weight fertilizer because 2.3 million tons of ammonium sulfate contain the same amount of nitrogen as the one million tons of urea. Data for 1952 illustrate the use of standard unit reporting. The tabulation below shows that the figure for ammonium nitrate expressed in standard units (derived as a residual) is consistent with the figure expressed as gross weight (from the First Five-Year Plan): The nitrogen content, and thus the nutrient value of the fertilizer, is the same in either case.

	Thousand Tons
Standard weight	
Total[1]	194.0
Ammonium sulfate[2]	181.4
Ammonium nitrate[3]	12.6
Gross weight	
Ammonium nitrate[4]	7.5

1. *Kung-jen jih-pao*, Peking, 21 September 1957.
2. *Jen-min jih-pao*, Peking, 16 August 1959, p. 7.
3. Residual.
4. *First Five-Year Plan for Development of the National Economy of the People's Republic of China in 1953-1957*, Peking, 1956, p. 48.

There is no direct evidence that the Chinese have changed this system, and recent statements imply that it is still in use. For example, Vice Premier Teng Hsiao-ping told a Peking audience in October 1974 that China's fertilizer goal is 60-70 million tons.* This level, which probably refers to 1980, could be reached only by converting the output of the urea plants now being imported from the West to its ammonium sulfate equivalent.

	Output as Reported (Thousand Tons)		Percent Nitrogen		Nitrogen Content (Thousand Tons)
Standard weight	12.6	X	20%	=	2.5
Gross weight	7.5	X	34%	=	2.5

* FBIS, *Daily Report*, People's Republic of China, 10 December 1974, p. E3.

Special Problem of Ammonium Nitrate

During the 1950s, fertilizer output was reported in two ways: including and excluding ammonium nitrate. In *Ten Great Years*, for example, it was explicitly excluded. Thus the output of ammonium nitrate was reported or could be derived.

Information on the production of ammonium nitrate for the years since 1958 is not available, and there is little information as to how output is divided between military and agricultural uses. Most Western studies have assumed that ammonium nitrate was included in the percentage increases and index numbers reported for the early 1960s. We believe, however, that it was not included.

Few observers have accepted the Chinese claim that fertilizer production increased 3 million tons in 1965. It was generally believed that an increase of this magnitude was not possible. However, if ammonium nitrate were excluded from claims for the years prior to 1965 but included in the 1965 total, an increase of about 3 million tons is reasonable.

In addition, Chou En-lai's recent claim that fertilizer production in 1974 was 4.3 times that of 1964 makes little sense unless the data reported for the early 1960s exclude ammonium nitrate. An estimate for 1974 based on this assumption yields a reasonable 1974 total. The alternative is to believe that 1974 production fell nearly 5 million tons below the well-substantiated 1973 figure.

For these reasons, we believe that ammonium nitrate was not included in the claims made for the years 1959 to 1964, but that it has been included in the claims made for 1965 and subsequent years.

APPENDIX B

DERIVATION OF THE PRODUCTION SERIES

Detailed data, including output by large and small plants, are presented in Table 3.

The following abbreviations are used in the documentation of the production series:

CKHW	*Chung-kuo hsin-wen*, Canton
FBIS	Foreign Broadcast Information Service, *Daily Report, People's Republic of China*
Chao	Kang Chao, *The Rate and Pattern of Industrial Growth in Communist China*, University of Michigan Press, 1965.
KJJP	*Kung-jen jih-pao*, Peking
JMJP	*Jen-min jih-pao*, Peking
NCNA	New China News Agency
SMCP	US Consulate General, Hong Kong, *Summary of Mainland China Press*
TGY	State Statistical Bureau, *Ten Great Years: Statistics of the Economic and Cultural Achievements of the People's Republic of China*, Foreign Language Press, Peking, 1960.
TKP	*Ta-kung pao*, Hong Kong
WHP	*Wen-hui pao*, Hong Kong

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Table 3

China: Production of Chemical Fertilizer in Standard Units

Thousand Metric Tons

	Total	Ammonium Nitrate	Total Excluding Ammonium Nitrate	Nitrogen			Phosphorus			Potassium		
				Total	Large Plants	Small Plants	Total	Large Plants	Small Plants	Total	Large Plants	Small Plants
1949	27	...	27	27	27	...	....	....	....	....	....	....
1950	70	...	70	70	70	....	....	....	....	....	....	....
1951	137	8	129	137	137	....	....	....	....	....	....	....
1952	194	13	181	194	194	...	....	....	....	....	....	....
1953	263	37	226	263	263	...	...	....	....	....	....	....
1954	343	45	298	343	343	....	....	....	...	....	...	....
1955	425	94	332	418	418	...	8	8	....	....	....	....
1956	663	140	523	586	586	...	77	77	....	....	....	....
1957	803	172	631	683	683	....	120	120	....	....	....	....
1958	1,354	543	811	1,010	1,010	....	344	344	....	....	....	....
1959	1,876	543	1,333	1,376	1,376	....	500	500	....	....	....	....
1960	2,523	543	1,980	1,723	1,723	....	800	600	200	....	....	....
1961	1,850	400	1,450	1,400	1,380	20	450	338	112	....	....	....
1962	2,775	600	2,175	2,220	2,160	60	555	355	200	....	....	....
1963	3,857	834	3,023	2,708	2,608	100	1,149	501	648	...	....	....
1964	5,785	1,250	4,535	3,560	3,329	231	2,225	600	1,625	...	....	....
1965	7,600	...	...	4,150	3,802	348	3,450	690	2,760	....	....	....
1966	9,600	...	...	4,833	4,253	580	4,677	1,437	3,240	90	....	90
1967	8,100	....	...	4,040	3,450	590	3,990	1,300	2,590	170	....	170
1968	9,200	...	...	5,200	3,500	1,700	4,070	1,375	2,695	230	...	230
1969	11,300	....	...	5,900	3,800	2,100	5,150	1,500	3,650	250	10	240
1970	14,000	....	...	7,810	4,450	3,360	5,900	1,550	4,350	290	20	270
1971	15,800	...	...	9,500	4,750	4,750	6,950	1,620	5,330	350	50	300
1972	19,840	...	...	11,723	5,744	5,979	7,738	1,934	5,804	380	50	330
1973	24,800	..	...	14,652	6,740	7,912	9,729	2,432	7,297	420	50	370
1974	24,875	....	...	15,810	7,905	7,905	8,615	1,615	7,000	450	50	400

Notes to Table 3

Total Production

1949-51: Sum of ammonium nitrate and total production excluding ammonium nitrate.

1952-54: Liu Chung-fan, "State Assistance to Peasants," *KJJP*, 21 September 1957.

1955-56: Chi Ch'ung-wei, "Industry Should Assist Agricultural Development," *Chi-hua ching-chi (Planned Economy)*, No. 10, 1957, p. 7.

1957: Wang Kuang-wei, "Modernizing Chinese Agriculture," *Peking Review*, Vol. 1, No. 5, 1958, p. 8.

1958-64: Sum of components.

1965: *Peking Review*, 16 April 1966 indicated an increase of 3 million tons. *JMJP*, 12 February 1966 reported a 70% increase over 1964. The figures derived from these statements are reasonably close, and our estimate falls between them. It is assumed that chemical fertilizer totals began to include ammonium nitrate in standard units in 1965. The reported 3-million-ton increase, therefore, is the difference between total output in 1965 and output excluding ammonium nitrate in 1964.

1966: Production increased 26% over 1965 (*JMJP*, 30 December 1966).

1967-69: Work stoppages and raw material shortages during the Cultural Revolution resulted in lengthy shutdowns of many industrial plants and a 10% to 15% decline in total output. As Red Guard activity declined in 1968, industrial output began to recover and surpassed its previous high by 1969. It is assumed that chemical fertilizer production dropped sharply in 1967 and followed the same pattern of recovery as for industry as a whole.

1970: Edgar Snow, "Talks with Chou En-lai," *The New Republic*, 27 March 1971.

1971: Production increased 20.2% over 1970 (*FBIS*, 3 January 1972, p. B10).

1972: Production increased 18.1% over 1971 (*FBIS*, 26 December 1972, p. B1).

1973: Production increased 25% over 1972 (*FBIS*, 14 January 1974, p. B10).

1974: Production was 430% of that in 1964 (Chou En-lai, "Report on the Work of the Government," *Peking Review*, 24 January 1975).

Ammonium Nitrate

1951: State Statistical Bureau, revised report for 1952.

1952-58: Residual. Derived as the difference between total production including and excluding ammonium nitrate.

1959: The amount of ammonium nitrate used in industry was to be increased (*Hua-hsueh kung-yeh* [*Chemical Industry*], 21 August 1959). The amount used as fertilizer was estimated to be the same as in 1958 on the assumption that the increase in production went to nonagricultural uses.

1960: Conservatively estimated to be the same as 1959.

1961-64: Production was assumed to have increased at the same rate as total output excluding ammonium nitrate.

1965: Assume the same as 1964.

Total Production Excluding Ammonium Nitrate

1949-58: *TGY*.

1959: *JMJP*, 22 January 1960.

1960: *Ekonomicheskaya Gazetta* (*Economic Journal*), 10 June 1961. The Soviets indicated the figure was taken from the Chinese press.

1961: Output in 1961 was 6.4 times the highest production prior to liberation (227,000 tons in 1941) (*TKP*, 1 October 1962).

1962: Production increased 50% over 1961 (*Peking Review*, 11 January 1963, p. 3).

1963: Production increased 39% over 1962 (*FBIS*, 2 January 1964, p. ccc 9-10).

1964. Production increased 50% over 1963 (*China Reconstructs*, February 1965).

Nitrogen

1949-54: Sum of ammonium nitrate and total production excluding ammonium nitrate.

1955-56. Sum of ammonium nitrate and ammonium sulfate. Ammonium sulfate reported by the State Statistical Bureau, *Basic Indicators of the Development of the National Economy of the CPR* (in Russian), p. 39.

1957-58. *CKHW*, 30 January 1959, p. 11.

1959-60. Residual.

1961. Small plant production of synthetic ammonia was 5,000 tons, or 2% of total nitrogen fertilizer output (*KJJP*, 15 June 1966). Small plant percentages refer to total nitrogen excluding ammonium nitrate. Large and small plant nitrogen production could be derived since one ton of synthetic ammonia yields four tons of ammonium bicarbonate.

1962. Production was 60 times the 1949 level (*FBIS*, 13 March 1963, p. ccc 5). Small plant production was estimated to provide a transition to later figures which could be more accurately determined.

1963. Total nitrogen production increased 22% (*TKP*, 16 December 1963, p. 1). Small plant ammonia production went up 66% over that of 1962 (*NCNA* 22 September 1964). The 66% increase was applied to small plant nitrogen fertilizer production.

1964. Small plant output doubled from 1963 (see source under Nitrogen for 1965) and small plant ammonia production was claimed to be 10% of the total (*NCNA*, 22 May 1964). Large plant output was derived by assuming the same percentage of nitrogen as for small plants.

1965. Peking stated (*KJJP*, 15 June 1966) that small plants accounted for 12% of total nitrogen output. Because there was an approximate yearly doubling of small plant nitrogen capacity since 1961 (*KJJP*, 15 June 1966), the small plant total could be estimated. Large plant nitrogen output could then be computed.

1966: On the basis of an approximate yearly doubling trend of small plant output noted above, 580,000 tons was taken for the 1966 production. Assuming that small plants accounted for 12% of nitrogen output as in the previous year, production was derived for large plants.

1967: Small plants were continuing to increase in capacity during this period.

1968: With continued increases in capacity, small plants were claimed to account for one-third of total nitrogen output (*JMJP*, 10 April 1969).

1969: Small plant nitrogen productive capacity was claimed to have increased about six times since 1965 (*Peking Review*, 13 June 1969). The figure thus obtained was increased slightly to provide a smooth transition between the small plant percentage shares given for 1968 and 1970.

1970: Small plant output went up 60% over 1969 and reached 43% of national nitrogen production (*Economic Reporter*, January-March 1971, p. 21). Large plant output was derived on the basis of this information.

1971: Total production was assumed to remain at approximately 56% of chemical fertilizer, and small plant output was claimed to account for 50% of the national nitrogen figure (*SCMP*, 15-19 May 1972, p. 210).

1972: *FBIS*, 26 December 1972, p. B1 specified a 23.4% increase in nitrogen fertilizer. Small plant production was estimated to have risen to 51% of the total.

1973: Total nitrogen production was estimated on the basis of maintaining a constant percentage of total chemical fertilizer. Small plants were estimated to have contributed 54% on the basis of their synthetic ammonia production (*NCNA*, 5 January 1974, p. 13).

1974: Output of coal fell, affecting the growth of output at small plants. As a result, total nitrogen production grew more slowly than in other recent years.

Phosphorus

1955-56: Residual. Derived as total less nitrogen.

1957-58: *CKHW*, 30 January 1959, p. 1).

1959-60: Production was assumed to grow at a faster rate than that of nitrogen because of its lower base figure.

1961: Residual. Small plant production was assumed to fall proportionately.

1962: Residual. As the small plant program was developing rapidly, it was assumed to have provided a larger proportion of production.

1962: Residual. Capacity was estimated to be less than 1.2 million tons by the *Journal of World P & K*, June 1963, p. 4).

1964: Residual. Capacity was reported to be more than 2 million tons (*JMJP*, 5 August 1964, p. 2). *CHCW*, 7 February 1965 claimed that 40% of total production came from small and medium-sized plants. Small plant production of phosphorus was derived by using small plant nitrogen output and total output.

1965: Residual. Small plants were claimed to have produced 80% of total phosphorus (*WHP*, 2 October 1966).

1966: Residual. Small plant capacity was claimed to have increased by 760,000 tons in 1966 (*NCNA*, 17 September 1966). The increase in production was estimated at two-thirds of that figure, based on assumed start-up difficulties.

1967: Small plants were assumed to have experienced a decline of 20% in output because of problems in general with extractive industries.

1968: Residual. Small plants were assumed to have produced the same proportion of the total as in the previous year.

1969: Residual. As conditions normalized, small plant production was assumed to have returned to 70% of the total as in 1966.

1970: Residual. Small plant production was estimated on the basis of the percentage role it played in 1973.

1971: Residual. Small plant output was derived from the claim that small plants produce 60% of all chemical fertilizer (*FBIS*, 3 January 1972, p. B12) and the small plant nitrogen figure.

1972: Small plants were assumed to have accounted for about 75% of the total on the basis of the claim for the following year.

1973: Residual. Small plants were claimed to have accounted for 75% of total phosphate production (*FBIS*, 14 January 1974, p. B10).

1974: Increases in the price of imported phosphate rock cut the purchases that predominantly feed large plants. Small plant output is likely to have fallen less as domestic rock deposits were utilized more intensively.

Potassium

Deposits in the dry salt lakes of Tsinghai Province are the main source of supply for potassium production, but are supplemented by sea salt recovery operations in the eastern provinces. The nature of production techniques makes it particularly difficult to estimate total output. The series presented here parallels recent British Sulfur Corporation figures (Statistical Supplement No. 10, Nov-Dec 1974).